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CLAIMS

1. A plasma processing unit comprising:

a processing container whose inner pressure can be reduced,

a first electrode arranged in the processing container,

a process gas supplying unit that supplies a process gas into the processing container,

a high-frequency electric power source that outputs high-frequency electric power having a frequency in a VHF band,

a matching unit electrically connected to the high-frequency electric power source and the first electrode for impedance matching, and

a transmission line that transmits the high-frequency electric power from the high-frequency electric power source to the matching unit,

wherein

a substrate to be processed is adapted to be arranged in the processing container,

the high-frequency electric power transmitted to the first electrode is adapted to generate plasma in such a manner that the substrate to be processed can undergo a plasma process by means of the plasma, and

the transmission line has a length shorter than a length wherein a resonance state of a third harmonic wave of the high-frequency electric power may be generated.

2. A plasma processing unit according to claim 1, wherein

the length of the transmission line is shorter than  $\lambda/2$ ,  $\lambda$  being a wavelength of the third harmonic wave of the high-frequency electric power, and

with respect to the third harmonic wave of the high-frequency electric power, an output terminal of the high-frequency electric power source and an input terminal of the matching unit are electrically short-circuited ends,

respectively.

3. A plasma processing unit according to claim 1, wherein the length of the transmission line is shorter than  $3\lambda/4$ ,  $\lambda$  being a wavelength of the third harmonic wave of the high-frequency electric power, and

with respect to the third harmonic wave of the high-frequency electric power, an output terminal of the high-frequency electric power source is an electrically short-circuited end and an input terminal of the matching unit is an electrically open end.

4. A plasma processing unit according to claim 1, wherein the high-frequency electric power source includes:

a high-frequency electric power generating part that generates the high-frequency electric power when direct-current power is supplied thereto, and

a filter that selectively allows the high-frequency electric power from the high-frequency electric power generating part to pass therethrough, and

the filter has an output terminal connected to the transmission line as an electrically short-circuited end with respect to the third harmonic wave of the high-frequency electric power.

5. A plasma processing unit according to claim 4, wherein the high-frequency electric power source further includes a circulator that allows a forward wave from the high-frequency electric power generating part to pass therethrough and that absorbs a reflected wave from the matching unit, between the high-frequency electric power generating part and the filter.

6. A plasma processing unit according to claim 1, wherein the transmission line consists of a coaxial cable.

7. A plasma processing unit according to claim 1, wherein the frequency of the high-frequency electric power is not less than 70 MHz.

8. A plasma processing unit according to claim 1, wherein a second electrode is arranged in the processing container in parallel with and opposed to the first electrode.

9. A plasma processing unit according to claim 8, wherein the substrate to be processed is adapted to be placed on the first electrode, and a vent hole is provided in the second electrode to jet out the process gas toward the first electrode.

10. A plasma processing unit according to claim 8, wherein the substrate to be processed is adapted to be placed on the second electrode, and a vent hole is provided in the first electrode to jet out the process gas toward the second electrode.

11. A high-frequency electric power supplying unit that supplies high-frequency electric power having a frequency in a VHF band to a first electrode arranged in a processing container whose inner pressure can be reduced, comprising:

a high-frequency electric power source that outputs the high-frequency electric power,

a matching unit electrically connected to the high-frequency electric power source and the first electrode for impedance matching, and

a transmission line that transmits the high-frequency electric power from the high-frequency electric power source to the matching unit, wherein

the transmission line has a length shorter than a length wherein a resonance state of a third harmonic wave of

the high-frequency electric power may be generated.

12. A high-frequency electric power supplying unit according to claim 11, wherein

the length of the transmission line is shorter than  $\lambda/2$ ,  $\lambda$  being a wavelength of the third harmonic wave of the high-frequency electric power, and

with respect to the third harmonic wave of the high-frequency electric power, an output terminal of the high-frequency electric power source and an input terminal of the matching unit are electrically short-circuited ends, respectively.

13. A high-frequency electric power supplying unit according to claim 11, wherein

the length of the transmission line is shorter than  $3\lambda/4$ ,  $\lambda$  being a wavelength of the third harmonic wave of the high-frequency electric power, and

with respect to the third harmonic wave of the high-frequency electric power, an output terminal of the high-frequency electric power source is an electrically short-circuited end and an input terminal of the matching unit is an electrically open end.

14. A high-frequency electric power supplying unit according to claim 11, wherein

the high-frequency electric power source includes:

a high-frequency electric power generating part that generates the high-frequency electric power when direct-current power is supplied thereto, and

a filter that selectively allows the high-frequency electric power from the high-frequency electric power generating part to pass therethrough, and

the filter has an output terminal connected to the transmission line as an electrically short-circuited end with respect to the third harmonic wave of the high-

frequency electric power.

15. A high-frequency electric power supplying unit according to claim 14, wherein

the high-frequency electric power source further includes a circulator that allows a forward wave from the high-frequency electric power generating part to pass therethrough and that absorbs a reflected wave from the matching unit, between the high-frequency electric power generating part and the filter.

16. A high-frequency electric power supplying unit according to claim 15, wherein

the high-frequency electric power generating part is connected via a cable to a direct-current power source that converts alternating-current power of commercial frequency into the direct-current power.

17. A high-frequency electric power supplying unit according to claim 11, wherein

the transmission line consists of a coaxial cable.

18. A high-frequency electric power supplying unit according to claim 11, wherein

the frequency of the high-frequency electric power is not less than 70 MHz.